OCT 4 1990

FLOOD INSURANCE STUDY

TOWNSHIP OF ADRIAN, MICHIGAN

LENAWEE COUNTY

NOVEMBER 16, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 260732

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY

TOWNSHIP OF ADRIAN,
LENAWEE COUNTY,
MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Adrian, Lenawee County, Michigan, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Detroit District (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-87-E-2509, Project Order No. 10. This study was completed in May 1988.

1.3 Coordination

On August 22, 1986, an initial coordination meeting was held with representatives of FEMA, the Michigan Department of Natural Resources (MDNR), the Township of Adrian and the Study Contractor.

The MDNR, Hydrologic Studies Unit, and Technical Studies Section, Water Management Division were contacted concerning unpublished data relevant to this study. They provided a number of discharge values for the study area. Results of the technical aspects of the study were coordinated with, reviewed and approved by the MDNR.

On December 6, 1989, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Adrian, Lenawee County, Michigan. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of Wolf Creek was studied in detail.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through May 1993. The scope and methods of study were proposed to and agreed upon by FEMA and the Township of Adrian.

2.2 Community Description

The Township of Adrian is in central Lenawee County, in southeastern Michigan. It is 70 miles southwest of Detroit. The township is bordered on the south by the City of Adrian and Madison Township, on the west by Rome Township, on the north by Franklin Township, and on the east by Raisin Township. The township is served by State Highways 34, 52, and U.S. Highway 223. The 1980 population of the Township of Adrian was reported to be 4,612 (Reference 1).

The topography within the township is level to gently rolling. Elevations range from about 710 feet National Geodetic Vertical Datum of 1929 (NGVD) along the downstream end of the River Raisin within the community to 910 feet NGVD in the northwest corner.

Land use within the township is mainly agricultural with some undeveloped land. There is also significant and expanding residential, commercial and industrial development. The majority of the development lies on highways serving the community. There is also increasing residential development along or near Wolf Creek.

The climate of the Township of Adrian is characteristic of southeastern Michigan and is predominately continental. The mean annual temperature is 48.9 degrees Fahrenheit (°F), with extremes ranging from -26°F to 108°F. The average annual precipitation is 33 inches and is well distributed throughout the year. The average annual snowfall is about 30 inches (Reference 2). The average annual runoff is approximately 10 inches (Reference 3).

2.3 Principal Flood Problems

Local officials indicated that low-lying areas along Wolf Creek frequently flood. There are no records available concerning these flood occurrences.

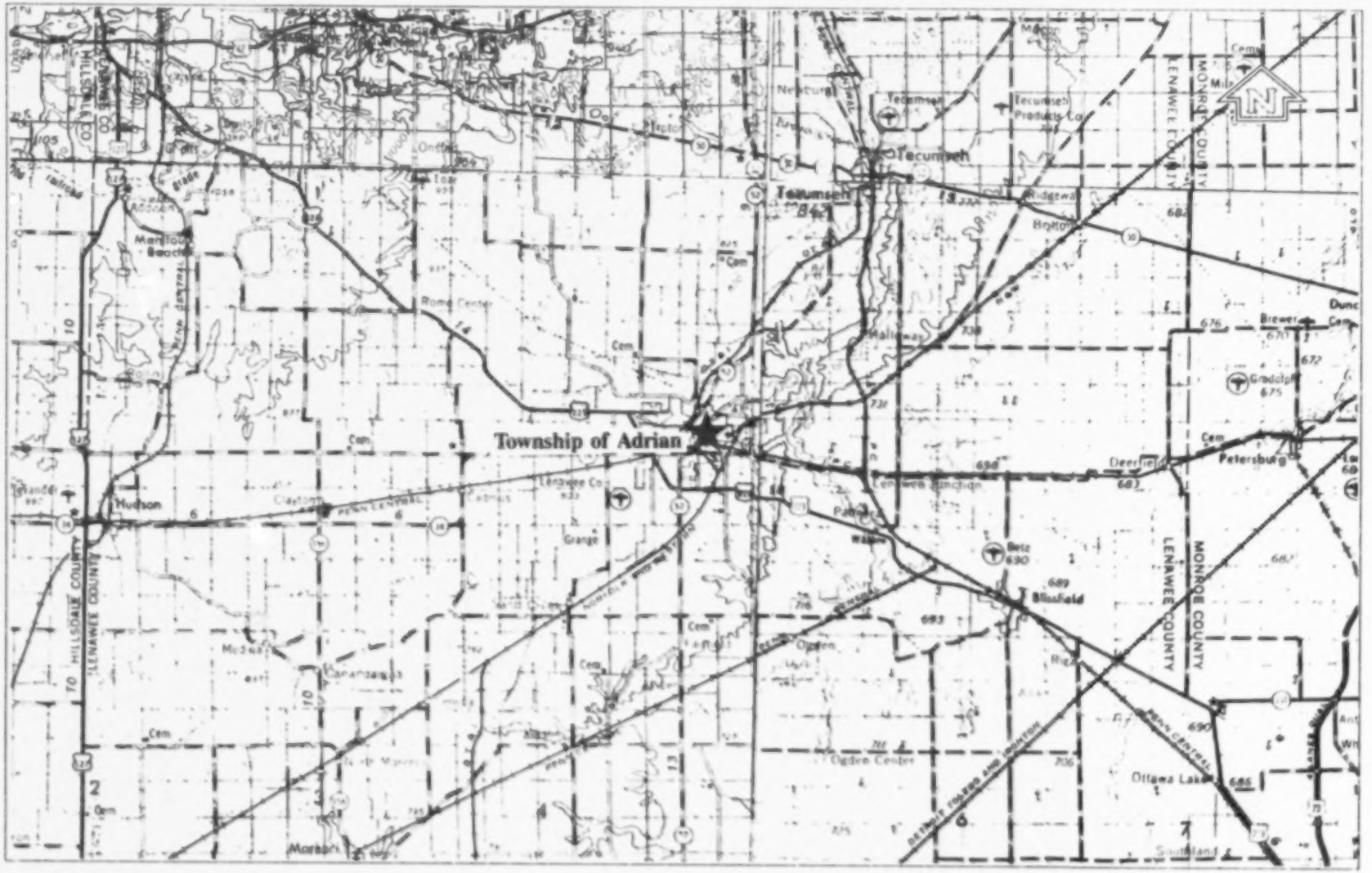


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF ADRIAN, MI

(LENAWEE CO.)

VICINITY MAP

Based on surrounding gages, the principal cause of flooding is intense rainstorms during wet periods or rain on frozen ground, possibly with melting snow.

2.4 Flood Protection Measures

Flood protection measures do not exist within the study area. Just south of the township, Bent Oak Dam forms Lake Adrian which extends into the Township (Reference 4). The lake's primary purpose is for water supply to the City of Adrian. Any regulation at the dam would have a limited area of impact.

Nonstructural measures in the form of State (Reference 5) and local ordinances govern floodplain development in the Township of Adrian.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40-percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60-percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Several previous studies have resulted in discharges being determined for Wolf Creek in Adrian Township. These include a Dam Safety Report for Bent Oak Dam (Reference 4), and a Flood Insurance Study for the City of Adrian (Reference 6). Additionally, a COE study has been completed for the Township of Adrian, but the flow value used in that study was taken from the Dam Safety Report (Reference 7). Due to the nature of considerations in the other studies, it was felt that an independent study for Wolf Creek using FEMA guidelines should be made. A statistical model used for predicting the 100-year discharge on natural streams was applied to Wolf Creek (Reference 8) and a 100-year discharge of 1,390 cfs was obtained.

This was compared to the 100-year inflow discharge to Lake Adrian of 1,840 cfs from the City of Adrian Flood Insurance Study determined using the Soil Conservation Service (SCS) TR-20 computer model. The SCS discharge value was determined to be representative of discharge conditions for Wolf Creek. Therefore, the discharge value of 1,840 cfs is being used in this study.

The peak discharge-drainage area relationship for the 100-year flood of Wolf Creek is shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 100-YEAR
WOLF CREEK about 1.0 mile downstream of Birnwick Road	N/A	1,840

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-section data for the backwater analyses were obtained by a field survey. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and on the Flood Insurance Rate Map.

Water-surface elevations of the 100-year flood were computed using the HEC-2 step-backwater computer program (Reference 9). The starting water-surface elevation for Wolf Creek was set equal to the 100-year Lake Adrian water-surface elevation at Bent Oak Dam, (Reference 4) plus 0.5 foot. The 0.5 foot was added due to starting the HEC-2 model at the inlet to Lake Adrian, at which point the transition from lake to normal stream channel is near completion.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas. The channel "n" values for Wolf Creek ranged from 0.035 to 0.045 and the overbank "n" values ranged from 0.03 to 0.08.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the NGVD. Elevation reference marks used in this study are shown on the map and described in the exhibit labeled Elevation Reference Marks.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24000 with a contour interval of 10 feet (Reference 10).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In Michigan though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public

Acts of 1968 (Reference 5), encroachment in the floodplain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the MDNR, Land and Water Resources Division, a floodway having no more than a 0.1-foot surcharge has been delineated for this study. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways for this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2, Floodway Data. The computed floodways are shown on the Flood Insurance Rate Map. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplain will not cause an increase in the base flood elevations greater than the State's allowable surcharge at any point within the community.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than the State's allowable surcharge at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

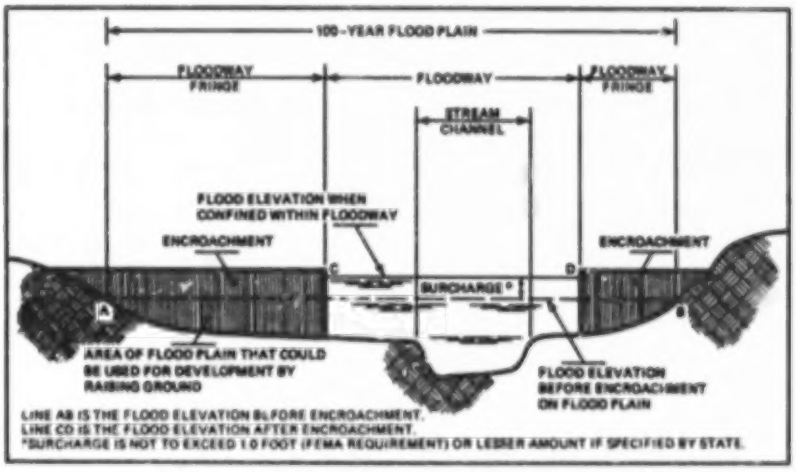

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
WOLF CREEK								
A	6000	516[2]	2139	0.9	763.0	763.0	763.1	0.1
B	11,200	415	1355	1.4	769.0	769.0	769.0	0.0
C	12,530	131	472	3.9	770.0	770.0	770.1	0.1
D	14,630	200	653	2.8	774.3	774.3	774.3	0.0
E	17,750	255	517	3.6	778.5	778.5	778.6	0.1
F	19,834	77	365	5.0	782.1	782.1	782.1	0.0
G	21,350	283	456	4.0	784.6	784.6	784.7	0.1
H	24,738	431	956	1.9	790.3	790.3	790.4	0.1
I	32,800	153	492	3.7	803.5	803.5	803.6	0.1

[1]FEET ABOVE BENT OAK DAM
[2] THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF ADRIAN, MI
(LENAWEE CO.)

FLOODWAY DATA

WOLF CREEK

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

The COE has completed two studies affecting flooding in the Township of Adrian (References 4 and 7). The stage discharge relationship for Bent Oak Dam is the same for both this study and the Dam Safety Inspection Report. The flooded area in this study is essentially the same or somewhat reduced in comparison to the COE study. This is in part due to a slightly lower discharge being used in this study. This and other differences are justified due to the more detailed nature of this Flood Insurance Study.

The Flood Insurance Study published for the City of Adrian (Reference 6) is in agreement with this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 175 West Jackson Boulevard, 4th Floor, Chicago, Illinois 60604-2698.

Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the map repository of flood hazard data located in the community.

9.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Department of Commerce, Bureau of Census, 1980 Census of Population of Inhabitants, Michigan, Washington, D.C., 1981.

2. Michigan Department of Agriculture, Michigan Weather Service, Climate of Michigan by Stations, State of Michigan, Lansing, Michigan, 1971.

3. U.S. Geological Survey, Water Resources Data for Michigan, Lansing, Michigan, 1986.

4. U.S. Army Corps of Engineers, Detroit District, Inspection Report, National Dam Safety Program, River Raisin Basin, Bent Oak Dam, City of Adrian, Lenawee County, Michigan, Detroit, Michigan, October 1978.

5. State of Michigan, Flood Plain Control Act of 1968, Act 245, P.A. 1929 as amended by Act 167, P.A. 1968, Michigan Water Resources Commission, Lansing, Michigan, 1968.

6. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Adrian, Lenawee County, Michigan, July 1982.

7. U.S. Army Corps of Engineers, Detroit District, Community Assistance Program Study for Adrian Township, Michigan, Detroit, Michigan, April 1986.

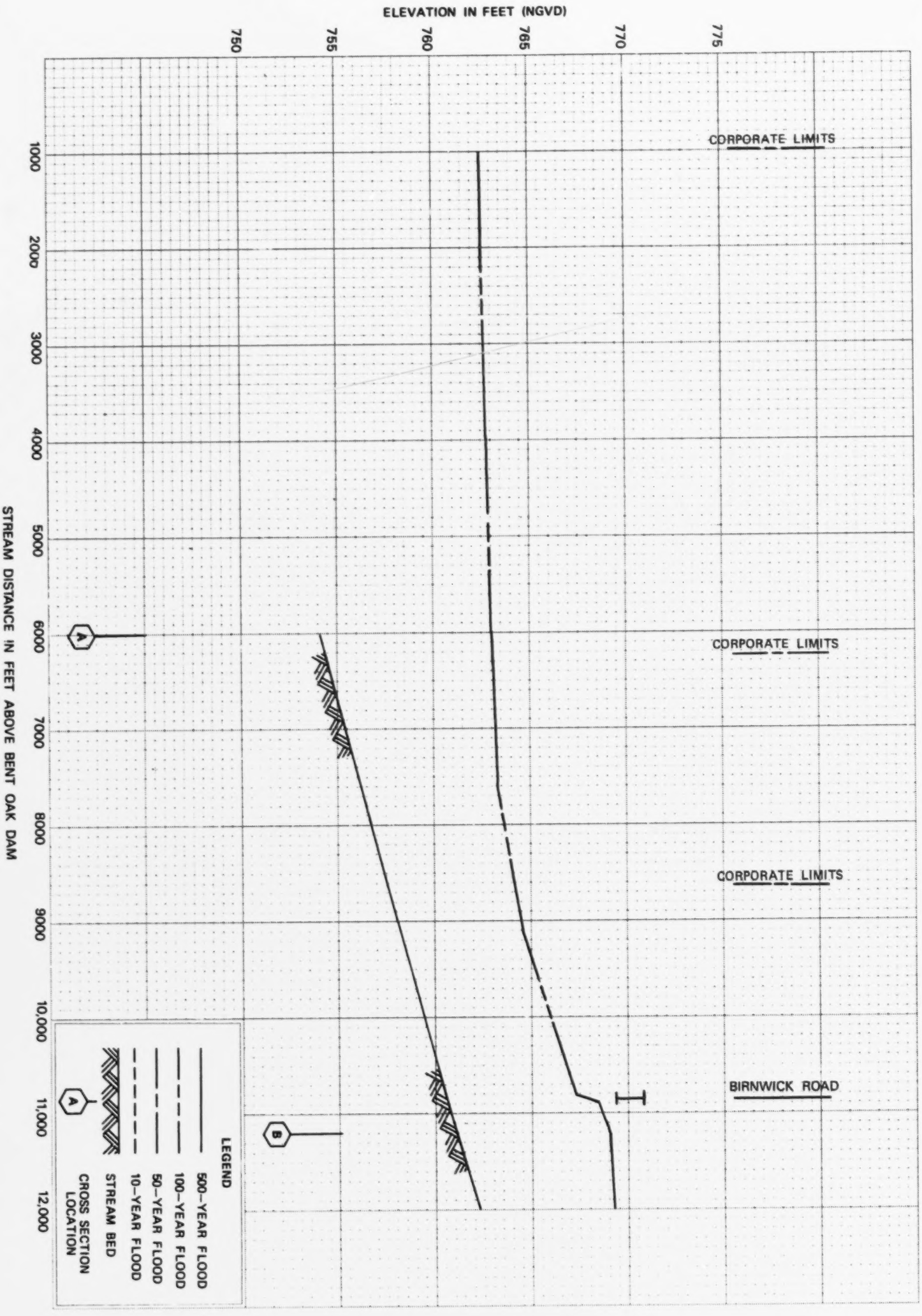
8. U.S. Geological Survey, Water-Resources Investigations Report 84-4207, Statistical Models for Estimating Flow Characteristics of Michigan Streams, Lansing, Michigan, 1984.

9. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, May 1984.

10. U.S. Geological Survey, Topographic Map, Scale 1:24000, Contour Interval 10 Feet, Adrian, Michigan, 1962, photorevised 1979.

ELEVATION REFERENCE MARKS

REFERENCE MARK	FLOOD INSURANCE RATE MAP PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
1	0016	777.00	chiseled square on top of parapet wall at southwest corner of Tipton Highway bridge over Wolf Creek
2	0016	775.89	chiseled square on middle step of concrete abutment at southwest corner of Country Club Road bridge over Wolf Creek
3	0012	785.06	chiseled square on concrete abutment at southwest corner of Wolf Creek Highway over Wolf Creek
4	0012	819.27	chiseled cross in east rim of manhole located on Wolf Creek Highway at intersection with Evergreen Drive
5	0012	819.25	railroad spike in south face of pole with transformer located on north side of U.S. Highway 223 about 150 feet east of Hamilton Highway
6	0012	812.98	chiseled square on concrete abutment at northeast corner of U.S. Highway 223 bridge over Wolf Creek



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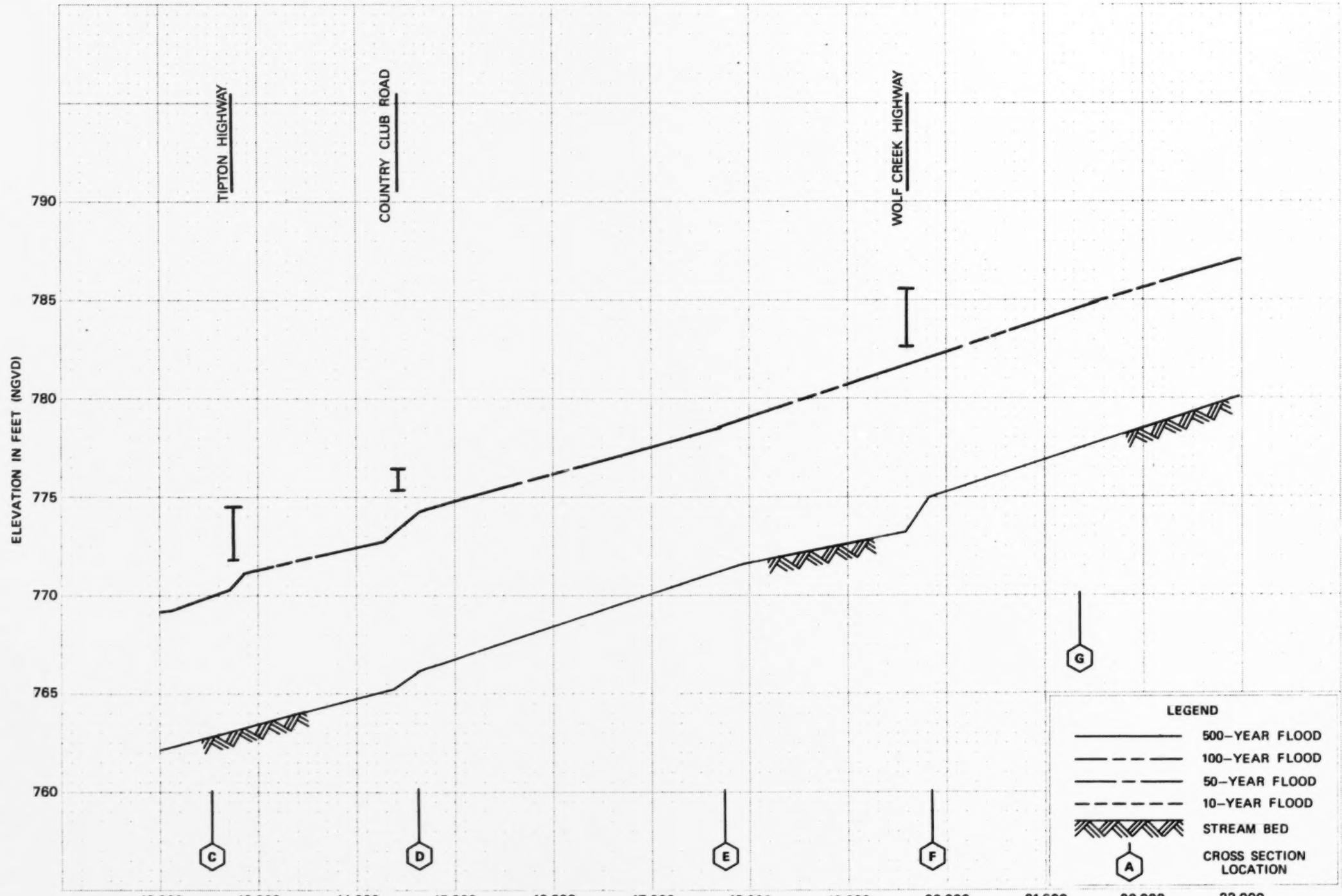
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF ADRIAN, MI
(LENAWEE CO.)

FLOOD PROFILES

WOLF CREEK



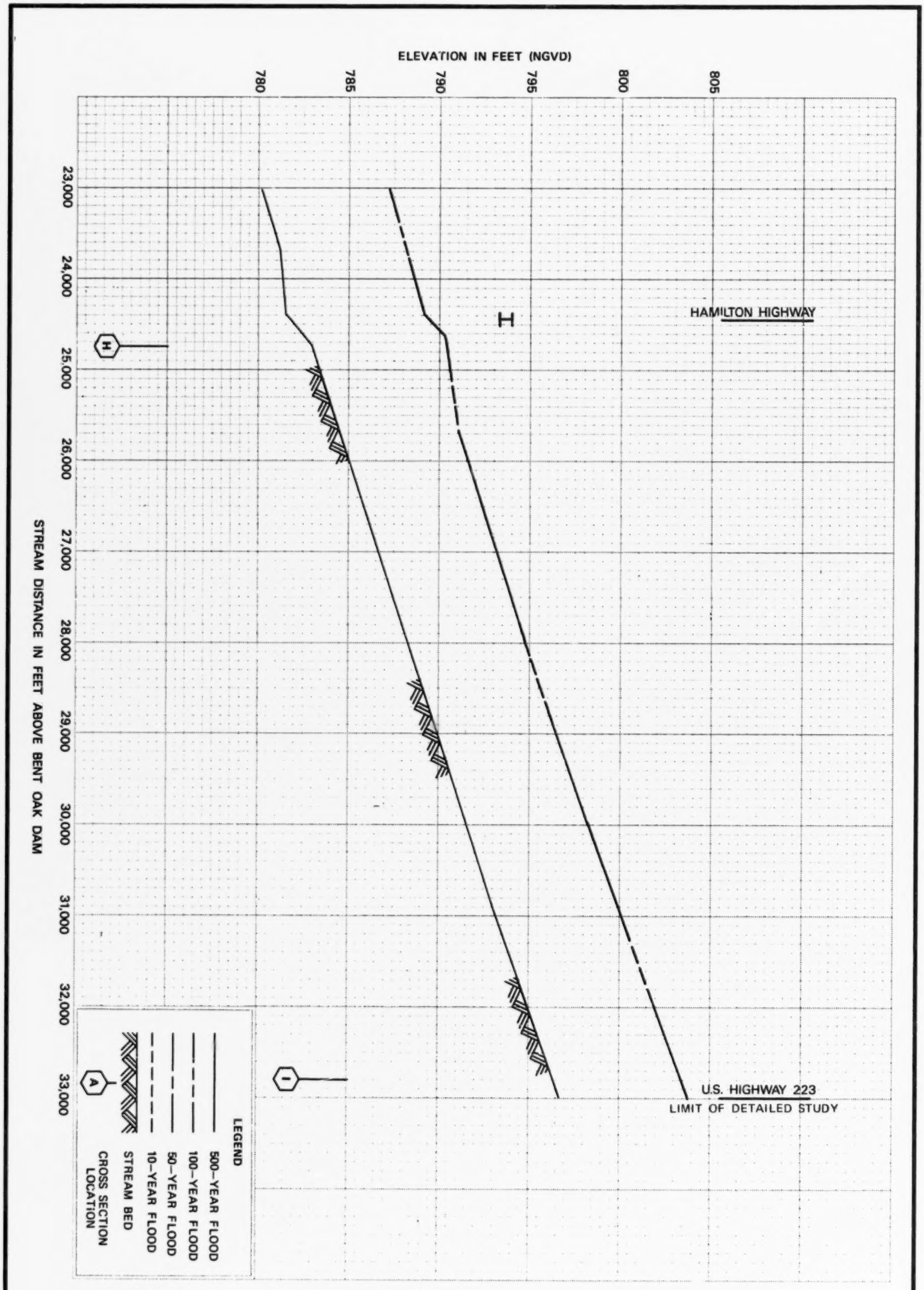
FLOOD PROFILES

WOLF CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF ADRIAN, MI
(LENAWEE CO.)

02P



03P	FEDERAL EMERGENCY MANAGEMENT AGENCY **TOWNSHIP OF ADRIAN, MI** (LENAWEE CO.)	**FLOOD PROFILES** **WOLF CREEK**